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(71) Applicant: THE PROCTER & GAMBLE COMPANY
One Procter & Gamble Plaza
Cincinnati Ohio 45202(US)

(72) Inventor: Nakel, Gunther Maria
R.R. 1, Box 836
Aurora, IN 47001(US)
Inventor: Heckert, David Clinton
3561 Kehr Road
Oxford, OH 45056(US)
Inventor: Mehansho, Haile (NMN)
7 Highknoll Court
Fairfield, OH 45014(US)
Inventor: Miller, Sandra Lee
9413 Daly Road
Cincinnati, OH 45231(US)

(74) Representative: Canonici, Jean-Jacques et al
Procter & Gamble European Technical Center N.V. Temselaan 100
B-1820 Strombeek-Bever(BE)

(54) Calcium-iron mineral supplements.

(57) Nutritional mineral supplements comprise a mixture of a calcium source, especially calcium citrate-malate, and an iron-sugar complex, especially iron sucrate-malate. Food and beverage compositions, especially juice beverages, supplemented with these calcium and iron materials are disclosed.

EP 0 297 679 A2

CALCIUM-IRON MINERAL SUPPLEMENTS

TECHNICAL FIELD

The present invention relates to mineral supplements which contain certain calcium and iron compounds, and foods and beverages containing same.

BACKGROUND OF THE INVENTION

Vitamin and mineral supplements for human and veterinary use are commonplace. Recently it has become recognized that certain groups of the human population may require quite high intakes of minerals, such as calcium, to prevent or alleviate certain disease states, for example, osteoporotic conditions. The medical management of certain anemias can be handled rather well by increasing the daily intake of iron. Some diets, or heavy physical exercise, may require the intake of considerable quantities of minerals apart from those generally obtained through what otherwise would be considered a balanced diet.

Mineral supplements, such as those commercially available, are useful in many circumstances where enhanced mineral uptake is desirable. However, adhering to a regimen which requires the separate intake of mineral supplements can give sub-optimal results, simply because the regimen requires a change in the normal habits and practices of the user. It would be more convenient if the minerals could be included in ordinary foods and beverages, so that they would be ingested without extra attention, planning and implementation on the part of the user.

There are well-recognized problems associated with adding mineral supplements to foods and beverages. For example, many calcium supplements tend to be rather insoluble, and, therefore, not very useful in beverages, or tend to have a "chalky" taste or mouth-feel. Iron supplements tend to discolor foodstuffs, or to be organoleptically unsuitable. Moreover, it is particularly difficult to formulate foods and, especially, beverages, containing mixtures of calcium supplements and iron supplements, inasmuch as these minerals tend to interact. This interaction not only affects the organoleptic and aesthetic properties of the foods and beverages, but also undesirably affects the nutritional bioavailability of these minerals, themselves.

It would be desirable, therefore, to have mixed calcium and iron supplements which are compatible and nutritionally available. It would also be quite useful to have such supplements which could be added to food and beverage compositions without undesirably affecting organoleptic or aesthetic properties.

It is an object of the present invention to provide calcium-iron mineral supplements which fulfill these unmet needs.

It is a further object of this invention to provide foodstuffs, beverages and beverage concentrates which are supplemented with calcium and iron.

These and other objects are secured herein, as will be seen from the following disclosure.

BACKGROUND ART

Certain forms of calcium citrate-malate are disclosed for use as mineral supplements, including beverages; see Japanese Application Sho 54-173172, date of application 28 December 1979, laid-open Sho 56-97248, 5 August, 1981; and see also French Patent 2.219.778 (Application 73.08643).

Some form of iron sucrate has been administered to children and the effect on Hb reported; see the Russian reference Metreveli, E.G., PEDIATRIYA (Moscow) 1977, (12), 17-19; C. Abs. 89:637.

Remington's Pharmaceutical Sciences, 15th Ed., 393 (1975) indicates that ferrous and ferric ions form soluble coordination complexes with many agents such as ammonium salts, citrates, tartrates, amines, sugar and glycerine, which protect the iron from precipitation by the usual iron precipitants. Iron gluconate and fumarate salts are said to be employed as hematinics.

Goodman and Gilman, The Pharmacological Basis of Therapeutics, 5th Ed., 1315-1316 (1975) reports that iron salts have many incompatibilities and should be prescribed alone, preferably between meals, for maximal absorption, but just after meals if necessary to minimize gastric symptoms. Gastrointestinal

absorption of iron is reportedly adequate and essentially equal from the following six ferrous salts: sulfate, fumarate, gluconate, succinate, glutamate, and lactate. Absorption of iron is lower from ferrous citrate, tartrate, pyrophosphate, etc. Reducing agents such as ascorbic acid and some chelating agents such as succinic acid may increase absorption of iron from ferrous sulfates, but are said to be not worth the extra cost because of the high efficacy of ferrous sulfate when administered alone. Ferrous sulfate is reported to have a saline, astringent taste, and is mixed with glucose or lactose to protect it against oxidation, when used as an iron supplement.

European Patent 164,657 to Pfeiffer and Langden relates to an iron dextran, which is obtained by adding precipitated ferric hydroxide to dextran produced by adding sucrose solution to a solution of D-glucose and dextran-sucrose enzyme.

U.S. Patent 4,582,709, to Peters and Derick, April 15, 1986, relates to chewable mineral supplements, and lists, inter alia, various calcium and iron compounds.

U.S. Patent 4,351,735, to Buddemeyer, et al. September 28, 1982, relates to mineral supplements which contain certain phosphate moieties. Dispersibility of the compositions is said to be enhanced by "hydroxyl sources", e.g., sugars.

U.S. Patent 4,214,996, to Buddemeyer, et al. July 29, 1980, relates generally to the same subject matter as the '735 patent, above, but claims, inter alia, iron compositions and calcium compositions.

The beneficial effect of orange juice on the uptake of iron from dietary sources is described by Carlson and Miller in JOURNAL OF FOOD SCIENCE 48, 1211 (1983).

U.S. Patent 2,325,360, to Ayres et al, issued July 27, 1943, discloses a method for replacing gases removed during deaeration of fruit juices, such as orange juice, with carbon dioxide. In this method, dry calcium carbonate, or a mixture of calcium carbonate and citric acid, is dropped into a can which is then filled with deaerated orange juice. (Other organic acids such as malic and tartaric acid can be used in place of citric acid.)

U.S. Patent 3,657,424, to Akins et al, issued April 18, 1972, discloses the fortification of citrus juices, including orange juice, with sodium, calcium and chloride ions in amounts beyond what is naturally present in the juice. Calcium salts which can be used in fortification include the chlorides, citrates or phosphates, although calcium chloride is preferred for providing the desired chloride ion.

U.S. Patent 3,114,641, to Sperti et al, issued December 17, 1963, discloses extended orange juice products obtained by diluting single-strength orange juice or concentrated orange juice. To maintain the flavor of the diluted orange juice product, materials such as calcium chloride, magnesium chloride, sodium or potassium citrates, tartaric and malic acids (or their salts) are included.

British Patent Specification 2,095,530, published October 6, 1982, discloses a process for obtaining an acid beverage enriched in protein, particularly a fruit juice or fruit-flavored beverage. In this process, an aqueous suspension of soy protein is prepared using water and/or fruit juice. Calcium in a concentration of from 5 to 50mM is added, after which the pH of the suspension is reduced and the insoluble material separated to yield a protein solution. A fruit juice or fruit flavoring can then be added to this protein solution. The calcium can be added in the form of the chloride, acetate, tartrate, malate or lactate salt.

European Patent Application 75,114, published March 30, 1983, discloses protein-containing fruit juice drinks enriched with vitamins and minerals. These drinks contain 30-90% fruit juice (a mixture of 20-70% apple juice, 4-40% white grape juice, 1-10% passionfruit juice and 5-25% lemon juice), 2 to 20% whey protein concentrate, and a mineral salt mixture of potassium, sodium, magnesium, calcium and phosphate. Calcium is present in these drinks at 0.01 to 0.3%, preferably at 0.02 to 0.03%.

SUMMARY OF THE INVENTION

The present invention encompasses nutritional mineral supplements which comprise a mixture of a nutritionally supplemental amount of a calcium source, especially calcium citrate-malate, and a nutritionally supplemental amount of an iron-sugar complex. The counterions associated with the iron-sugar complexes herein, are preferably members selected from the group consisting of malate (most preferred), citrate, tartrate, ascorbate, and mixtures thereof. Preferred supplements contain iron sucrate-malate, iron fructate-malate, or mixtures thereof. Preferably, the iron in the complexes comprises ferrous iron, but ferric iron is also acceptable.

The invention also encompasses food, beverage or beverage concentrate compositions which comprise:

a) a foodstuff, beverage or beverage concentrate;

b) a nutritionally supplemental amount of a calcium supplement, most preferably calcium citrate-malate; and

c) a nutritionally supplemental amount of an iron-sugar complex, preferably a member selected from the group consisting of iron sucrate-malate (most preferred), iron fructate-malate, iron sucrate-citrate, iron fructate-citrate, iron sucrate-ascorbate, iron fructate-ascorbate, or mixtures thereof. Again, the iron is preferably in the ferrous state.

Typical of the compositions of this invention are beverage or beverage concentrates which comprise:

a) at least about 0.1% by weight of fruit or cola flavor, or at least about 3% by weight of fruit juice;

b) a nutritionally supplemental amount of calcium citrate-malate; and

c) a nutritionally supplemental amount of an iron-sugar complex, most preferably iron II sucrate-malate.

By way of example, the fruit juice in such compositions can be selected from grape juice, pear juice, passionfruit juice, pineapple juice, banana juice or banana puree, apricot juice, orange juice, lemon juice, grapefruit juice, apple juice, cranberry juice, tomato juice, tangarine juice, and mixtures thereof.

The invention encompasses beverages, especially juice and cola beverages, which are carbonated in the manner of soft drinks, as well as "still" beverages. The invention also encompasses nectars and full-strength beverages or beverage concentrates which contain at least about 45% by weight of juice.

The nutritional supplements herein are particularly useful with beverages or beverage concentrates made from orange juice or grapefruit juice.

As will be disclosed more fully hereinafter, the mineral supplements of this invention can conveniently be used in powder, tablet, chewable lozenge, capsule or liquid form, for enteral or parenteral nutrition, and in combination with conventional foodstuffs, such as breads, cakes, snacks, infant formulations, meat analogs and extenders, spreads, and the like.

All ratios, proportions and percentages herein are by weight, unless otherwise specified.

DETAILED DESCRIPTION OF THE INVENTION

The present invention involves the conjoint use of nutritionally-supplemental amounts of calcium and iron compounds in humans and lower animals.

By "nutritional" or "nutritionally-supplemental amount" herein is meant that the mineral sources used in the practice of this invention provide a nourishing amount of said minerals. In mineral supplements such as tablets or powders, this supplemental amount will comprise at least 3% of the Recommended Daily Allowance (RDA) of the daily intake of said mineral, as defined in The United States of America (see Recommended Daily Dietary Allowance-Food and Nutrition Board, National Academy of Sciences-National Research Council). More generally, mineral supplements will contain at least 10%, more typically 50% to 300%, of the RDA per unit dose of the supplement. In food or beverage products of the type disclosed herein, the nutritionally supplemental amount will generally comprise more than 3% of the RDA, preferably 10%-100% RDA, most preferably 10%-30% of the RDA, per unit portion of the food or beverage product. Of course, it is recognized that the preferred daily intake of any mineral may vary with the user. For example, pregnant, lactating, or post-menopausal females may require an increased intake of calcium, over the usual RDA. Persons suffering with anemia may require an increased intake of iron. Such matters are familiar to physicians and nutritional experts, and usage of the compositions of the present invention may be adjusted accordingly.

In general, the RDA (calcium) will range from 360 mg per 6 Kg for infants to 1200 mg 54-58 Kg female, depending somewhat on age. The RDA (iron) ranges from 10 mg per 6 Kg to 18 mg per 54-58 Kg female, depending somewhat on age. As is well-known, it is possible to overdose with iron supplements, especially in males, with deleterious effects to the liver. Typically, foods and beverages are supplemented with only about 10-15% RDA iron (based per serving) to account for iron which is available from other dietary sources (assuming a reasonably balanced diet), thereby avoiding this problem. Moreover, it can be difficult to supplement beverages with more than 20-30% RDA of calcium (based per serving) without encountering precipitation and/or organoleptic problems. However, this level of supplementation is equivalent to cow's milk in calcium value, and is quite acceptable. Of course, if iron toxicity and organoleptic quality are not deemed important considerations in individual circumstances, more of the supplements herein can be used.

The preparation of the preferred calcium source used herein, "calcium citrate-malate", is described hereinafter in considerable detail.

The "iron-sugar" complexes used in the practice of this invention are prepared in the manner described

more fully hereinafter. (These materials are referred to herein as "complexes", but they may, in fact, exist in solution as complicated, highly-hydrated, protected colloids. However, the term "complex" is used herein for simplicity.) While the iron in these complexes can be in the ferric (iron III) state, it is more preferably in the ferrous (iron, II) state. Ferrous iron is better tolerated and utilized by the body than ferric iron. Importantly, ferric iron and common ferrous salts can cause off-flavors in some beverages, after storage; ferric iron can also oxidize and thus degrade ascorbic acid (Vitamin C) in citrus beverages. The preferred complexes used herein can conveniently be thought of as iron-sugar-carboxylate complexes, wherein the carboxylate provides the counterion for the ferrous (preferred) or ferric iron. While not intending to be limited by theory, it is believed that the acceptable taste of these iron complexes is due to the relatively large sizes of the sugar moiety and carboxylate counterion, which mask the usual "well-water" and or brackish flavor of some iron supplements.

The overall synthesis of the preferred iron-sugar-carboxylate complexes used in the practice of this invention involves:

a) forming a calcium-sugar moiety in aqueous media, for example, by reacting calcium hydroxide with a sugar;

b) reacting an iron source, such as ferrous ammonium sulfate, with the calcium-sugar moiety in aqueous media to provide an iron-sugar moiety; and

c) neutralizing the reaction system with a carboxylic acid, for example, malic acid, to provide the desired iron-sugar complex.

The preferred iron II-sucrate-malate complex prepared in this manner is essentially equivalent to ferrous sulfate in iron bioavailability (measured as % change in hematocrit of test animals over the range of 0-9 ppm Fe), and, most importantly, is organoleptically acceptable in beverages, especially citrus beverages.

The "sugars" which can be employed in the practice of this invention include any of the ingestible saccharidic materials, and mixtures thereof, well-known in the culinary arts. For example, glucose, sucrose and fructose can conveniently be employed, with sucrose and fructose being the more preferred. However, other saccharidic materials can be used, for example mannose, galactose, lactose, maltose, and the like.

The "carboxylate counterion" used in the preparation of the preferred iron-sugar complexes herein can be any ingestible carboxylate species. However, some judgment must be made with regard to flavor contribution. For example, citrate, malate and ascorbate yield ingestible complexes whose flavors are judged to be quite acceptable, particularly in fruit juice beverages. Tartaric acid is acceptable, particularly in grape juice beverages, as is lactic acid. Longer-chain fatty acids may be used in solid mineral supplements, but can affect flavor and water solubility. For essentially all purposes, the malate (preferred), citrate and ascorbate moieties suffice, although others can be selected, according to the desires of the formulator.

In a less preferred mode, the counterion for the iron-sugar complex can be noncarboxylate moieties such as phosphate, chloride, sulfate, or the like. However, such counterions can undesirably interact with calcium ions, especially in beverages. In high concentrations, these counterions may contribute an undesirable flavor note. Accordingly, the carboxylate counterions noted above are preferred herein.

The present invention is particularly suited for the preparation of juice beverages and beverage concentrates, particularly orange juice. The concentrated orange juice, orange juice aroma and flavor volatiles, pulp and peel oils used in the method of the present invention can be obtained from standard orange juice processing. See Nagy et al, Citrus Science and Technology, Volume 2, (AVI Publishing Co. 1977), pp 177-252 (herein incorporated by reference) for standard processing of oranges, grapefruit and tangerines. (See also Nelson et al. Fruit and Vegetable Juice Processing Technology (3rd Ed., AVI Publishing 1980),pp. 180-505 (herein incorporated by reference) for standard processing of noncitrus juices such as apple juice, grape juice, pineapple juice etc. to provide sources of juice and juice materials for mineral-supplemented noncitrus juice products). Fresh juice is extracted from the oranges, principally of the Valencia type. (The peel of the oranges is initially rasped to provide peel oils which can be used in the method of the present invention.) Juices from different oranges are frequently blended to adjust the sugar to acid ratio. A sugar to acid ratio of from about 8:1 to about 20:1 is considered acceptable. However, preferred sugar to acid ratios are typically from about 11:1 to about 15:1.

Juice is extracted from the oranges by using automatic juicing machines, or less often by hand squeezing of the oranges. The type of equipment used to extract the juice is not critical. The raw juice exiting from the squeezing device contains pulp, rag and seeds. The rag and seed are separated from the juice and pulp in a finisher. The juice is then typically separated into a pulp portion and a serum portion. (The pulp portion can be used as a source of pulp in the method of the present invention.)

The serum portion can be concentrated by a variety of techniques which typically include evaporative concentration or freeze concentration. In evaporative concentration, the serum portion of the juice is passed through an evaporator (e.g., falling film or temperature accelerated short time evaporator [TASTE] type).

Water vapor as well as the aroma and flavor volatiles, are stripped from the juice. These stripped volatiles are then centrifuged to provide an upper layer (essence oils) and a lower layer (aqueous essence). (A portion of these essence oils and aqueous essence are typically used as the source of orange juice aroma and flavor volatiles for the method of the present invention.) The remaining stripped juice is then concentrated in the evaporator (by heat) to the appropriate amount of solids as measured by the sugar content of the concentrated juice. This concentrated juice can then be used in the method of present invention.

Most concentrated orange juices are obtained by evaporative concentration. However, freeze concentration can also be used to obtain concentrated orange juice useful in the method of the present invention. Freeze concentration typically involves passing the serum portion of the juice through a scraped wall heat exchanger to form substantially pure ice crystals which are then separated from the concentrated juice. A preferred freeze concentration method is disclosed in U.S. Patent 4,374,865 to Strobel, issued February 22, 1983, which is incorporated by reference. Unlike evaporative concentration, concentrated orange juice obtained by freeze concentration typically contains the aroma and flavor volatiles as well.

Method for Preparing Beverages and Beverage Concentrates Supplemented with Calcium and Iron

The preferred overall method for preparing the liquid compositions herein involves preparing premix solutions of the calcium and iron complexes (see Examples I, II and III, hereinafter) and admixing the premixes to the liquid compositions. The following discussion of this method will generally be with regard to formation of orange juice beverages and juice concentrates, which are highly preferred fruit juice products according to the present invention. However, this method can also be used to prepare iron- and calcium-supplemented beverages and concentrates, especially those based on other citrus juices such as grapefruit juice, noncitrus juices such as apple juice, as well as mixtures of juices.

In general, an acid component comprising citric acid and malic acid is typically dissolved in the appropriate quantity of water. (If desired, fruit juice or concentrated fruit juice such as lemon juice can be used to supply a portion of the acids.) Generally, this acid component comprises from 0 to about 90% by weight citric acid and from about 10 to 100% by weight malic acid. For orange juice, this acid component typically comprises from about 20 to about 90% by weight citric acid and from about 10 to about 80% by weight malic acid. Preferably, this acid component comprises from about 5 to about 60% by weight citric acid and from about 40 to about 95% by weight malic acid. (For noncitrus juices such as apple juice, this acid component typically comprises from about 5 to about 80% by weight citric acid and from about 20 to about 95% by weight malic acid, and preferably comprises from about 20 to about 50% by weight citric acid and from about 50 to about 80% by weight malic acid.) As a rule, the ratio of these acids is selected to provide optimum flavor character in the juice.

Once the solution containing the dissolved acids is formed, a source of calcium is then added. Calcium carbonate ($CaCO_3$) is a preferred calcium source. This calcium source leads to the greatest and most rapid initial solubilization of calcium and causes the least amount of off-flavor generation. Calcium hydroxide [$Ca(OH)_2$] and calcium oxide (CaO) are also acceptable calcium sources, but can cause more off-flavor generation than calcium carbonate. The weight ratio of total acids to calcium added in the solution is typically from about 0.5 to about 12. Preferably, this weight ratio is from about 1 to about 6.

Addition of calcium carbonate, calcium oxide, or calcium hydroxide to the aqueous solution of acids provides a premix containing soluble and solubilizable calcium. This is due to the fact that highly soluble calcium citrate and malate species such as CaHcitrate, $Ca(H_2citrate)_2$, and CaHmalate are formed in the solution due to the reaction between the calcium source and the acids. Without added stabilizers, the highly soluble calcium citrate species are stable in the premix solution for periods up to only about a few hours. After this short period of time, the highly soluble citrate species tend to disproportionate to the corresponding acid and the more thermodynamically stable, insoluble calcium citrate salts, such as Ca_3 $citrate_2$.

To improve the stability of the more soluble calcium malate and especially citrate species in the premix solution, it is preferred in the method of the present invention to include a premix stabilizer. Materials which can complex with calcium and/or act as crystallization inhibitors are useful as premix stabilizers. These materials include sugars, such as sucrose, glucose, fructose, high fructose corn syrup, invert sugar, and polysaccharides such as pectin, algins, hydrolyzed starches, xanthan gum, and other edible gums. Concentrated juices which naturally contain both sugars and polysaccharides are particularly suitable premix stabilizers. Preferred premix stabilizers are sucrose and high fructose corn syrup (especially for extended juice products) and concentrated orange juice having a sugar content of from about 35 to about

80° Brix whose source is described hereafter.

The premix stabilizer can be added immediately after the calcium source is added to the aqueous solution containing the acids. (When calcium carbonate is the calcium source, carbon dioxide evolution is preferably allowed to substantially cease before the premix stabilizer is added.) However, if desired, the premix stabilizer (especially in the case of sugars and concentrated juice) can be added to the aqueous solution of the acids prior to addition of the calcium source. The amount of premix stabilizer included in the premix solution typically depends upon the stabilizer used. When sugars are used as the premix stabilizer, they are typically added in an amount sufficient to provide a sugar content of from about 2 to about 40° Brix. When polysaccharides are used, the amount can vary widely, but is typically from about 0.01 to about 0.5% on a weight volume basis. When concentrated juice is used as the premix stabilizer, it is typically included in an amount sufficient to provide a sugar content of from about 2 to about 40° Brix (preferably from about 2 to about 24° Brix).

The premix solution of solubilized and solubilizable calcium is typically prepared in a batch-type fashion, as in the description above, at room temperature. However, this premix solution can also be prepared in a continuous fashion. In this continuous method, the ingredients (water, acids, calcium source and optional premix stabilizer) are constantly metered together to form the premix solution. The level at which the ingredients are metered is adjusted, as necessary, to insure appropriate solubilization of the calcium in the premix solution and to provide the appropriate acidity.

Separately, a premix solution of the iron-sugar complex is prepared. In general, this solution is somewhat simpler to prepare than the calcium citrate-malate solution, above, since precipitation is not a major problem. Thus, a calcium-sugar reaction product is treated with an iron (preferably iron II) source, and the reaction product is neutralized with a carboxylic acid, in the manner of Example III, below.

The premix solution containing the solubilized calcium and the premix containing the solubilized iron are combined in a mix tank with chilled (e.g., below about 4.4° C) concentrated orange juice having a sugar content of from about 35 to about 80° Brix (preferably from about 60 to about 70° Brix), orange juice aroma and flavor volatiles, plus other orange juice materials such as pulp and peel oils, to provide iron- and calcium-supplemented orange juice products. The particular proportions of premix solution, concentrated juice, aroma and flavor volatiles, pulp and peel oils used will depend upon a number of different factors, including the type of orange juice product involved (single-strength juice beverage or juice concentrate). For example, iron- and calcium-supplemented 42° Brix orange juice concentrates can be prepared by combining 65 parts concentrated orange juice (65° Brix), 5 parts pulp, 15 parts of an aroma/flavor concentrate, 0.4 parts peel oil with the 15 parts Fe/Ca premix. Similar single-strength juice beverages can be prepared by appropriate variation of the amounts of concentrated orange juice, pulp, aroma/flavor concentrate, peel oil and premix solutions, as well as the inclusion of water.

Juice compositions and other beverages are preferably formulated at a pH below about 4.3, generally about 3.7-4.0, for reasons of microbial stability.

After the iron- and calcium-supplemented orange juice product is obtained, it is then filled into cans, cartons, bottles or other appropriate packaging. In the case of orange juice concentrates, these products are typically frozen after being filled into cans.

The following examples illustrate the practice of this invention but are not intended to be limiting thereof.

EXAMPLE I

Preparation of Calcium Citrate-Malate

A calcium citrate-malate solution is prepared by dissolving 2 parts sucrose and then 0.1 part citric and 0.28 part malic acids in 28.19 parts water. Calcium hydroxide (0.22 part) is added and the mixture is agitated. This solution can be used directly to prepare beverages, or can be freeze-dried to use in solid mineral supplements.

EXAMPLE II

Preparation of Calcium Citrate-Malate Without Sugar

In an alternate mode, the sucrose can be deleted from the above preparation. Thus, a calcium citrate-malate solution is prepared by admixing 62 g calcium carbonate with 11 g citric acid and 44 g malic acid in 1.040 g water. This solution can be used to prepare low calorie beverages, beverage concentrates, or freeze-dried for use in solid supplements.

EXAMPLE III

Preparation of Iron II Sucrate-Malate

Sucrose (85.5 g) is dissolved in water (299.8 g), making sure that dissolution is complete. Calcium hydroxide (18.5 g) is then added, and the mixture is stirred for 5 minutes. Any clouding is observed, and the resulting solution is filtered through a glass filter paper.

To the resulting calcium-sucrate solution is added ferrous ammonium sulfate hexa-hydrate (24.5 g), and the solution is covered air-tight (e.g., SARAN wrap). The green color indicates the iron is in the desired II oxidation state.

To the above solution is added malic acid (33.5 g) in 3 batches, to pH 3-4. The precipitated calcium malate is filtered through standard filter paper, but the filter cake comprising calcium sulfate is not rinsed. The resulting solution comprises the iron sucrate-malate used in the practice of this invention. The solution can be used per se, or can be freeze-dried to provide the iron sucrate-malate in powder form.

EXAMPLE IV

Mixed Composition

The calcium citrate-malate composition of Example II and the iron sucrate-malate composition of Example III are, separately, freeze-dried and ground to a fine powder. The powders are mixed to provide individual unit doses comprising 1,200 mg calcium and 20 mg iron. The mixed powders are packaged in soluble gelatin capsules for oral ingestion as a calcium-iron mineral supplement.

EXAMPLE V

Mixed Composition

In an alternate mode, a calcium and iron supplement powder mixture is prepared from the calcium citrate-malate of Example I and the iron sucrate-malate of Example III, and adjusted in bulk with powdered lactose to provide a mineral supplement powder which delivers 1,500 mg calcium and 10 mg iron per 10 g dose.

EXAMPLE VI

Beverage Compositions

The following beverage compositions (a-g) are fortified with the calcium and iron compositions of Examples I and III to provide 20% RDA of calcium and 10% RDA of iron per 180 ml serving:

a) "sparkling" orange juice comprising 55% orange juice and 45% carbonated water;

b) pear-grapefruit nectar comprising 25% pear juice, 20% grapefruit juice, the balance comprising 10% sucrose-water;

c) kiwi-grapefruit drink comprising 20% kiwi fruit juice, 15% grapefruit juice, the balance comprising water;

d) mixed fruit "cocktail" comprising 10% each of the juices of passion fruit, mango, guava, pineapple, papaya, banana, apricot, mandarin orange, pear and lime juices;

e) yogurt fruit beverage comprising 20% milk products, 1% pectin, 20% pineapple juice, 10% shredded pineapple fruit pulp, 16% corn syrup, the balance comprising water;

f) cola beverage comprising 0.35% cola flavor emulsion, 11% sugar, 0.1% phosphoric acid, 0.1% citric and malic acids, caramel coloring, the balance comprising carbonated water;

g) full-strength apple juice (using the calcium citrate-malate of Example II in place of the Example I material).

EXAMPLE VII

Food Compositions

The following food compositions (a-f) are fortified with the mixed calcium-iron composition of Example IV to provide 100% RDA of calcium and 20% RDA of iron per 250 g serving:

a) salted potato snack product comprising moistened, comminuted potato flakes, shaped and deep-fried in the form of saddle-shaped chips;

b) peanut butter product comprising finely ground peanuts, up to 3% peanut oil, salt;

c) cookie product comprising inner core of flour, shortening, flavoring and fructose enrobed in outer layer of flour, shortening, flavoring and sucrose;

d) brownie snack product comprising commercial DUNCAN HINES brownie mix;

e) soy-based meat analog product comprising a 50:1 (wt.) mixture of de-oiled soybean meal and egg whites, extruded, in patty or chunk form;

f) infant formulation in powder or liquid form comprising sterilized soy powder or soy "milk", vanilla flavor, preservative.

It should be appreciated that the calcium source in the solid food compositions and the solid unit dosage forms herein need not be restricted to calcium citrate-malate for organoleptic stability reasons, as in the case of beverages and beverage concentrates. Materials such as calcium chloride, hydroxide, carbonate, etc., can alternatively be used. However, the superior bioavailability of calcium from calcium citrate-malate makes this the preferred calcium supplement for use in the practice of this invention with solid foods and supplements, as well as with beverages and beverage concentrates.

EXAMPLE VIII

Mineral Supplement

A powdered mineral supplement comprises 2,000 mg calcium carbonate and 15 mg iron (II) fructate-malate, prepared in the manner of Example XX, hereinafter.

EXAMPLE IX

Orange Juice Concentrate

A highly preferred orange juice concentrate comprises:

Ingredient	Amount (g)
65° Brix orange juice concentrate	2070
Aqueous orange essences	550
Orange pulp	270
Orange oil	2
Orange flavor mix	14
Calcium citrate-malate premix solution of Example I	To 800 mg Ca^{++} 180 ml portion*
Ferrous sucrose-malate premix solution of Example III	To 7.2 mg Fe^{++} 180 ml portion*

*When diluted to single strength

EXAMPLE X

Orange Juice or Nectar

The concentrate of Example IX can be diluted with water to provide a single-strength orange juice.

In an alternate mode, the concentrate of Example IX is diluted to 45% juice levels with sugar-water to provide an orange nectar.

EXAMPLE XI

Iron- and calcium-fortified chewable lozenges comprise:

Ingredient	Amount
Iron II sucrate-ascorbate	20 mg
Calcium citrate-malate	500 mg
Dextrose	5 g
Fruit flavor*	6 mg
Color	As desired

The lozenge of Example XI is prepared by mixing the ingredients and compacting the mixture in a

standard press.

*Fruit flavors used herein generally comprise synthetically reconstituted flavor esters. In this example, pineapple flavor is used, and comprises a synthetic mixture of ethyl acetate, acetaldehyde, methyl n-valerate, methyl i-valerate, methyl i-caproate and methyl caprylate.

The following examples illustrate syntheses of various iron compositions which can be used in the practice of this invention.

EXAMPLE XII

Iron II Sucrate-Malate

Sucrose (1368 g; 4 moles) is dissolved in water (3995 g), making sure all sugar is dissolved. Calcium hydroxide (148 g; 2 moles) is added to the sugar-water and stirred for 5 minutes. The solution is filtered through a glass filter.

To the calcium-sucrate solution is added iron II ammonium sulfate (196 g; 0.5 moles) and covered air-tight with SARAN WRAP. The color should remain green. Malic acid (268 g; 2 moles) is added in three batches. At each addition, a pH reading is taken with litmus paper to insure pH 3-4. The precipitate is filtered-off with a paper filter, and the filter cake is not rinsed. The compound is in the filter liquor.

EXAMPLE XIII

Iron II Sucrate-Malate

Sucrose (684 g; 2 moles) is dissolved in water (2226 g), making sure all sugar is dissolved. Calcium hydroxide (74 g; 1 mole) is added to the sugar-water and stirred for 5 minutes. The solution is filtered through a glass filter.

To the calcium-sucrate solution is added iron II ammonium sulfate (196 g; 0.5 mole) and the solution is covered air-tight with SARAN WRAP. The color should remain green. Malic acid (268 g; 2 moles) is added in three batches. At each addition, a pH reading is taken with litmus paper to insure pH 3-4. The precipitate is filtered (paper filter), and the filter cake is not rinsed. The title compound is in the filter liquor.

EXAMPLE XIV

Iron II Sucrate-Malate

Sucrose (684 g; 2 moles) is dissolved in water (2856 g), making sure all sugar is dissolved. Calcium hydroxide (148 g; 2 moles) is added and the solution is stirred for 5 minutes. The solution is filtered through a glass filter.

To the calcium sucrate solution is then added iron II ammonium sulfate (392 g; 1 mole) and the system is covered air-tight with SARAN WRAP. The green color should remain. Malic acid (268 g; 2 moles), is added in three batches. At each addition, a pH reading is taken with litmus paper to insure pH 3-4. The precipitate is filtered (paper filter) and the filter cake is not rinsed. The title compound is in the filter liquor.

EXAMPLE XV

Iron II Fructate-Malate

Fructose (360 g; 2 moles) is dissolved in water (1644 g), making sure all fructose is dissolved. Calcium hydroxide (148 g; 2 moles) is added to the fructose solution and stirred for 5 minutes. The solution is filtered through a glass filter.

To the calcium fructose solution is added iron II ammonium sulfate (196 g; 0.5 mole) and the solution is covered air-tight with SARAN WRAP. The color should remain green. Malic acid (268 g; 2 moles) is added in three batches. At each addition, a pH reading is taken with litmus paper to insure pH 3-4. The precipitate is filtered off (paper filter). The title compound is in the filter liquor.

EXAMPLE XVI

Iron II Sucrate-Citrate

Sucrose (684 g; 2 moles) is dissolved in water (2399 g), making sure all sugar is dissolved. Calcium hydroxide (148 g; 2 moles) is added to the solution and stirred for five minutes. The solution is filtered through a glass filter. To the calcium-sucrate solution is added iron II ammonium sulfate (196 g; 0.5 mole) and the solution is covered air-tight with SARAN WRAP. The green color should persist. Citric acid (384 g; 2 moles) is added to the reaction mixture in three batches. At each point of addition, a pH reading is taken with litmus paper to insure pH 3-4. The precipitate is filtered-off (paper filter) and the filter cake is not rinsed. The title compound is in the filter liquor.

EXAMPLE XVII

Iron II Sucrate-Tartrate

Sucrose (684 g; 2 moles) is dissolved in water (2399 g), making sure all sugar is dissolved. Calcium hydroxide (148 g; 2 moles) is added to the sugar solution and stirred for 5 minutes. The solution is filtered through a glass filter.

To the calcium-sucrate solution is added iron II ammonium sulfate (196 g; 0.5 mole) and the solution is covered air-tight with SARAN WRAP. The green color should persist. Tartaric acid (300 g; 2 moles) is added to the solution in three batches. At each time of addition, a pH reading is taken with litmus paper to insure pH 3-4. The precipitate is filtered (paper filter) and removed; the filter cake is not rinsed. The title compound is in the filter liquor.

EXAMPLE XVIII

Iron II Glucate Fructate-Malate

Glucose (360 g; 2 moles) and fructose (360 g; 2 moles) are co-dissolved in water (1643 g), making sure all sugar is dissolved. Calcium hydroxide (148 g; 2 moles) is added to the sugar-water and stirred for 5 minutes. The solution is filtered through a glass filter.

To the calcium mixed sugars solution is added iron II ammonium sulfate (196 g; 0.5 moles) and the solution is covered air-tight with SARAN WRAP. The green color should persist. Malic acid (268 g; 2 moles) is added in three batches. At each addition, a pH reading is taken with litmus to insure pH 3-4. The precipitate is filtered-off (paper filter) and the filter cake is not rinsed. The title compound is in the filter liquor.

EXAMPLE XIX

Iron II Sucrate-Citrate-Ascorbate

Sucrose (684 g; 2 moles) is dissolved in water (2399 g), making sure all sugar is dissolved. Calcium hydroxide (148 g; 2 moles) is added to the sugar water solution and stirred for 5 minutes. The solution is filtered through a glass filter.

To the calcium-sucrate solution is added iron II ammonium sulfate (196 g; 0.5 mole) and the solution is covered air-tight with SARAN WRAP. The green color should persist. The citric acid (192 g; 1 mole) is first added to the solution, then the ascorbic acid (352 g; 2 moles) is added in three batches. At each time of addition, a pH reading is taken with litmus paper to insure pH 3-4. The precipitate is filtered (paper filter). The title compound is in the filter liquor.

EXAMPLE XX

Iron II Fructate Malate

Fructose (541 g; 3 moles) is dissolved in water (1672 g), making sure all is dissolved. Calcium hydroxide (37 g; 0.5 moles) is added and stirred for 5 minutes. The solution is filtered through a glass filter.

To the calcium-fructose solution is added iron II sulfate (139 g; 0.5 mole), and the solution is covered air-tight with SARAN WRAP. The color should remain green. Malic acid (67 g; 0.5 moles) is added to the solution in three batches. At each addition, a pH reading is taken with litmus paper to insure pH 3-4. The precipitate is filtered-off (paper filter) and the filter cake is not rinsed. The title compound is in the filter liquor.

Potentiators

The foregoing compositions function exceptionally well as mixed iron-calcium supplements. However, it has now also been determined that certain materials act as "potentiators", which still further enhance the bioavailability of calcium. Fructose is one such potentiator, and other carbohydrates, such as sucrose, function similarly, albeit less well than fructose.

However, iron bioavailability is somewhat impaired by the administration of calcium, and this impairment remains, even in the presence of usually-found levels of carbohydrates, including fructose.

It has now been found that citric acid (or citrates) and tartaric acid (tartrates) partially alleviate calcium's inhibitory effect on iron, and mixtures of citric/ascorbic acid (or citrate/ascorbate mixtures), do overcome the inhibitory effect.

Accordingly, in a preferred mode, this invention also uses a potentiating amount of citrate; or, preferably, citrate/ascorbate; or, citrate/fructose; or, citrate/ascorbate/fructose, or like tartrate combinations,

to potentiate iron and calcium bioavailability when these minerals are administered conjointly. It will be appreciated by the formulator that these potentiators can simply be added to the above-exemplified compositions, if not already inherently present.

By "potentiating amount" of the citrate, tartrate, ascorbate, carbohydrate (especially fructose), and mixtures thereof, materials used herein is meant an amount sufficient to enhance uptake and bioavailability of iron and calcium when administered to humans or lower animals. Of course, even small amounts of these potentiators have some beneficial effect. However, it is preferred to use sufficient potentiator to provide bioavailability levels of the iron calcium mixtures which are essentially equivalent to iron and calcium supplements when administered separately, and several hours apart. Fortunately, the potentiators used herein are entirely safe for consumption, so there is essentially no upper limit to the amount that can be safely ingested. Moreover, in practical terms, the potentiators are inexpensive, so there is no need for the formulator to carefully balance benefit:cost ratios. Typically, then, the citrate, tartrate and ascorbate potentiators are used in a weight ratio with the minerals (calculated as iron and calcium per se, discounting associated ions or ligands) of potentiator:mineral ranging from 1000:1 to 1:3, generally 3:1 to 1:1. The fructose potentiator may be used in much higher ratios, say, 10^3:1, since the formulator may also find it useful to include fructose, not only for its potentiating effect, but also for its bulk sweetener effect.

EXAMPLE XXI

Mineral Supplement

A powdered mineral supplement comprises 2,000 mg calcium citrate-malate, 15 mg iron (II) fructate-malate prepared in the manner of Example XX , 250 mg citric acid and 100 mg ascorbic acid.

Claims

1. A nutritional mineral supplement, characterized in that it comprises a mixture of:
   i) a nutritionally supplemental amount of a calcium source, preferably calcium citrate-malate; and
   ii) a nutritionally supplemental amount of an iron-sugar complex, said iron-sugar complex preferably having a malate, citrate, tartrate, or ascorbate counterion, or a mixture thereof.

2. A mineral supplement according to Claim 3, characterized in that the iron-sugar complex is iron sucrate-malate, iron fructate-malate, or a mixture thereof and, preferably, the iron is in the ferrous state.

3. A food, beverage or beverage concentrate composition, characterized in that it comprises:
   a) a foodstuff, beverage or beverage concentrate;
   b) a nutritionally supplemental amount of a calcium supplement, preferably calcium citrate; and
   c) a nutritionally supplemental amount of an iron-sugar complex, preferably iron sucrate-malate, iron fructate-malate, iron sucrate-citrate, iron fructate-citrate, iron sucrate-ascorbate, iron fructate-ascorbate, or a mixture thereof.

4. A composition according to Claim 3 characterized in that the iron is in the ferrous state.

5. A beverage or beverage concentrate composition according to Claim 3 or 4, characterized in that it comprises:
   a) at least 0.1% by weight of fruit or cola flavor, or at least 3% by weight of fruit juice;
   b) a nutritionally supplemental amount of calcium citrate-malate; and
   c) a nutritionally supplemental amount of an iron-sugar complex.

6. A composition according to Claim 5 characterized in that it contains fruit juice selected from grape juice, pear juice, passionfruit juice, pineapple juice, banana juice or banana puree, apricot juice, orange juice, lemon juice, grapefruit juice, apple juice, cranberry juice, tomato juice, and mixtures thereof.

7. A composition according to Claim 3, 4, 5, or 6 characterized in that the iron-sugar complex is iron II sucrate-malate.

8. A juice beverage according to Claim 12 characterized in that it is carbonated.

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(71) Applicant: THE PROCTER & GAMBLE COMPANY
One Procter & Gamble Plaza
Cincinnati Ohio 45202(US)

(72) Inventor: Nakel, Gunther Maria
R.R. 1, Box 836
Aurora, IN 47001(US)
Inventor: Heckert, David Clinton
3561 Kehr Road
Oxford, OH 45056(US)
Inventor: Mehansho, Haile (NMN)
7 Highknoll Court
Fairfield, OH 45014(US)
Inventor: Miller, Sandra Lee
9413 Daly Road
Cincinnati, OH 45231(US)

(74) Representative: Canonici, Jean-Jacques et al
Procter & Gamble European Technical Center N.V. Temselaan 100
B-1820 Strombeek-Bever(BE)

(54) Calcium-iron mineral supplements.

(57) Nutritional mineral supplements comprise a mixture of a calcium source, especially calcium citrate-malate, and an iron-sugar complex, especially iron sucrate-malate. Food and beverage compositions, especially juice beverages, supplemented with these calcium and iron materials are disclosed.

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EUROPEAN SEARCH REPORT

Application Number

EP 88 20 1347

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
D,A	PATENT ABSTRACTS OF JAPAN vol. 5, no. 168 (C-77) (840) 27 October 1981; & JP - A - 56 97248 (SHIROU TANAKA) 05.08.1981	1	A 23 L 1/304 H 23 L 2/26
A	US-A-3 809 773 (G. N. BOOKWALTER) * column 6, example 13; claims 1-3 *	1,6	
A	GB-A-2 172 788 (THE HOWARD FOUNDATION) * page 9, example 12 *	1	
A	FR-A-2 154 397 (CARLO ERBA S.P.A.) * claims 1,3 *	1	
D,A	GB-A-2 095 530 (SOCIETE DES PRODUITS NESTLE SA) * claims 1,5 *	1,6	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

A 23 L 1/00
A 23 L 2/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	21-07-1989	SCHULTZE D

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
O : non-written disclosure
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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Metallic Compounds of Amino Acids and Preparation thereof

We, MEDICAL RESEARCH PROPRIETARY LIMITED, a company incorporated in the State of New South Wales, Commonwealth of Australia, of Scot Chambers, Hosking Place, Sydney, New South Wales, Australia, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement :—

In the past many different organic compounds of iron have been incorporated in foods and have otherwise been prepared for medical purposes. Examples of such compounds are those of iron and ammonium citrate, thio-compounds in conjunction with organic acid radicals, ferrous and ferric gluconates and the like. As such compounds are not in a highly biochemically active form, it has been necessary to administer them in very large doses, in some cases up to 90 grains per day. By this invention organic compounds of iron, are prepared in a highly active form, that is, in a form which very closely approximates to the form in which iron is contained in blood hæmoglobin or other body fluids. It follows that advantages due to the present invention are that dosages may be considerably reduced, by comparison with what has been regarded as normal dosage heretofore, due to the compounds subject hereof being much more readily and much more completely capable of assimilation.

To be of any appreciable metabolic value iron must be in combination with amino acids, and it is believed that in so far as iron has been capable of assimilation by humans or animals it is because it is converted to this amino acid form within the alimentary system. So far as is known, iron compounds of all the amino acids derivable from a proteinous material have not hitherto been synthesised as a readily assimilable group other than within a living human or animal body as a metabolic function thereof. The present invention has been devised to synthesize iron compounds with all the amino acids obtainable from a common proteinous material thus to provide an admixture of amino acid salts which closely approaches the complex amino acid salt admixture present in natural hæmoglobin.

The method subject hereof consists in the preparation of a complex admixture of amino acid salts of iron in a form substantially the same as that of the amino acid salts of iron occurring in natural hæmoglobin, comprising the steps of enzymatically digesting a proteinous material to free amino acids therefrom ; and, without separating any of said acids, reacting the entire admixture thereof with an iron compound selected from the group consisting of the hydroxides, hydrated oxides and carbonates of iron. The reaction of the amino acid admixture with the iron compound may be carried out at ordinary room temperatures, but for preference (in order to shorten the reaction time) the reaction is carried out at an elevated temperature, of the order, for example, of 60–80° C. If desired, the step of reacting the amino acids with the iron compound may consist in first reacting the amino acid admixture with a soluble salt of sodium or other metal other than iron, and then forming the required complex admixture of amino acid salts by double decomposition between the amino acid salts of the metal other than iron with an iron salt.

Practically any protein substance may be employed as starting material herein. Such substance may be casein, gelatine, yeast, soya bean flour, egg albumen, vegetable or animal albumen or a mixture of two or more such protein substances in any proportions.

The ph value of the protein is first adjusted in accordance with the nature of the protein used and the enzymes to be used in the digestion.

The digestion may be carried out under acid, neutral or alkaline conditions. With acid digestion pepsin is added to the proteins as an enzymatic or catalytic agent. The

amount of pepsin may vary from the merest trace up to as much as or more than 10 per cent by weight of the proteins. In the case of neutral digestion the preferred enzymatic or catalytic agent is papain used in the same quantities as indicated above, with alkaline digestion the preferred enzymatic agent is pancreatic extract also in the same proportions. After addition of the enzymatic agent the temperature of the batch is adjusted to give optimum enzymatic action. This temperature may be from about 35° to 40° C. Digestion is then allowed to proceed, giving an admixture of amino acids, polypeptones and the like, and unconverted proteins. It will be understood that depending on the progress of the digestion and the nature of the proteinous matters used, the digestion may be carried out in several stages, in some of which the ph value may be varied so that a digestion which commenced as an acid process is carried on as a neutral or alkaline process, the procedure being varied to give a high amino acid yield; and, as far as possible, to exhaust the proteins present. The mixture resulting from digestion then has its ph value adjusted to from 3·6 to 4·6 (preferably about 4), that is, if it is not already of about this hydrogen ion concentration. This frees the amino acids from combination. For many medicinal uses it is not harmful for the salts, peptides, unconverted proteins and other matters to remain with the amino acids.

To produce an iron compound or compounds with the amino acids, a soluble salt or salts of iron is or are converted to hydrate, hydroxide or carbonate form. The hydroxide form is preferable and may be brought about by addition of caustic soda or other alkali. In either case this action gives a precipitation which, if required, enables unwanted salts or the like to be removed. Alternatively, such salts may be allowed to remain if they are biochemically unobjectionable or in some cases medicinally desirable (as may be the case where glauber salts or other medicinal agents are formed). The iron hydrate, hydroxide or carbonate is then mixed with the amino acids still in accompaniment with unconverted proteins, peptones and the like in such proportions as will give the resultant mixture a ph value equal or about equal to from 6·5 to 7. This admixture is sufficient to give the required iron compounds of the amino acids. A typical example of the invention is set forth below.

EXAMPLE

MANUFACTURE OF A COMPLEX BIOLOGICALLY ACTIVE IRON COMPOUND

5 pounds of casein, 2 pounds of gelatine, and 70 pounds of water are mixed and the resulting solution subjected to enzymatic hydrolysis by the addition of approximately 20 grammes of pancreatic extract.

Sufficient sodium carbonate is added to adjust the ph to between 7·3 and 8·0 and the whole maintained at a temperature of between 38/40° centigrade until hydrolysis has reached a stage where between 60 and 70% at least of the protein is hydrolized.

The above solution is then adjusted to a ph 4·3 by the addition of sulphuric acid, when a previously prepared hydroxide of iron is added to the amino acid hydrolysate and the whole thoroughly agitated and maintained at a temperature of between 60 and 80° centigrade (preferably under vacuum) until ph of 6·5 to 7·0 is obtained.

The clear solution obtained after filtration is concentrated to any degree or to dry powder form as required.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A method of preparing a complex admixture of amino salts or iron in a form substantially the same as that of the amino acid salts of iron occurring in natural hæmoglobin, comprising the steps of enzymatically digesting a proteinous material to free amino acids therefrom, and, without separating any of said acids, reacting the entire admixture thereof with an iron compound selected from the group consisting of the hydroxides, hydrated oxides and carbonates of iron.

2. A method according to Claim 1, wherein the said step of reacting an entire admixture of amino acids with an iron compound is carried out at an elevated temperature.

3. A method according to Claim 1, wherein the said step of reacting an entire admixture of amino acids with an iron compound, consists in first reacting the amino acids of said admixture with a soluble salt of a metal other than iron, and then forming the required complex admixture of amino acid salts by double decomposition between said amino acid salts of a metal other than iron with an iron salt.

4. A method according to Claim 1, wherein the step of digesting a proteinous material is performed under alkaline conditions and by use of pancreatic extract as enzymatic agent.

5. A complex admixture of amino acid salts of iron when prepared by a method according to any of the preceding claims.

Dated this 16th day of June, 1948.

MEDICAL RESEARCH PROPRIETARY LIMITED,
By:
ERIC POTTER & CLARKSON,
Chartered Patent Agents,
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